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FILTRATION PLANT, CITY OF DECATUR, ILLINOIS[1]

By Harry Ruthrauff

The main filter building covers the filters proper and housing all the piping and appurtenances necessary for the control and operation of the filters. The coagulant storage tanks and feeding devices contained within this building are at an elevation sufficient to permit the flow of the coagulant into the water as it enters the sedimentation basins.

Plans were prepared by William G. Clark, consulting engineer, which plans gave, in general, the necessary dimensions and the arrangement of the various basins and units of filtration, leaving to the bidders the detailing of the equipment for the filtration plant and chemical appliances, in accordance with plans to be prepared by them.

As is usual in these matters, the responsibility for the construction of the work rested on the bidders, and this was especially true as to the equipment; they furnishing their own plans and specifications.

The work was divided into several items upon which bidders could offer in part or as a whole. It was, however, provided that, "those bidding upon items 14, 15, 16, 17 and 18 must accompany their bid with as complete information as possible as to the size, character of raw water, results and cost of purification, etc., of the various plants which they constructed or equipped with appliances relative to water purification for domestic purposes."

As these items comprise the equipment of the plant, it is assumed that the successful bidder would be competent to carry out the various details because of previous experience in this very class of work.

A comparison of the various bids submitted with the items described in the specifications of W. G. Clark, C.E., develops the fact that of the bidders figuring on the construction work, only, items 1 to 13, H. C. Gass was the low bidder, and, of those bidding on the entire items, that is to say, the construction work plus the equipment, the New York Continental Jewell Filtration Company's bid was the lowest.

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[1] Read at meeting Illinois Section, American Water Works Association, March 10, 1915.

Certain changes were pointed out following the submission of bids whereby the low bidder on the entire contract, the New York Continental Jewell Filtration Company, offered to reduce their figures by the amount of $3000 on revised plans to be made by them, subject to the approval of the consulting engineer for the city, and this proposition was finally accepted under date of April 17, 1913.

Work was at once begun, and progressed as rapidly as was consistent with the development of the detail plans necessary to this character of construction.

This plant has now been in successful operation since September 23, 1914, the representatives of the company advised that the plant was completed and filtered water actually in the clear-water basin. The operator for the city was called in and his instructions started as per contract requirements.

Some difficulty was encountered subsequent to this owing to the fact that the city sewer was of insufficient capacity to carry off the wash water, and this was remedied.

As completed, the following detail of this plant may be of interest:

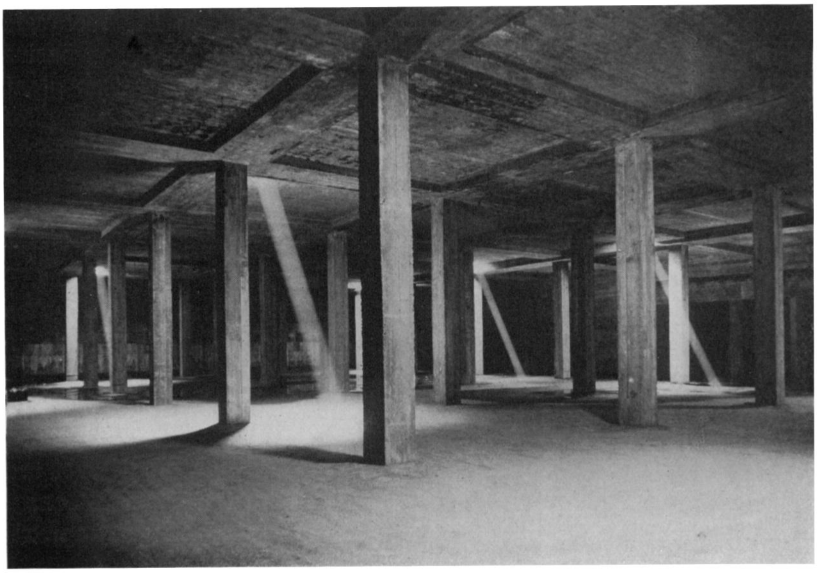
The excavation was in clay almost entirely, of such a character that the vertical walls cut clean, the deepest part of the excavation being that occupied by the sedimentation basins and the clear-water well, from elevation 990 approximately to elevation 1012.

The plant, outside of the sedimentation basins, occupied a rectangular space of approximately 138 feet by approximately 228 feet, and rested on a 6-inch concrete slab, reinforced with ½-inch steel bars, crossed both ways, so as to afford strength to carry the side walls and various columns.

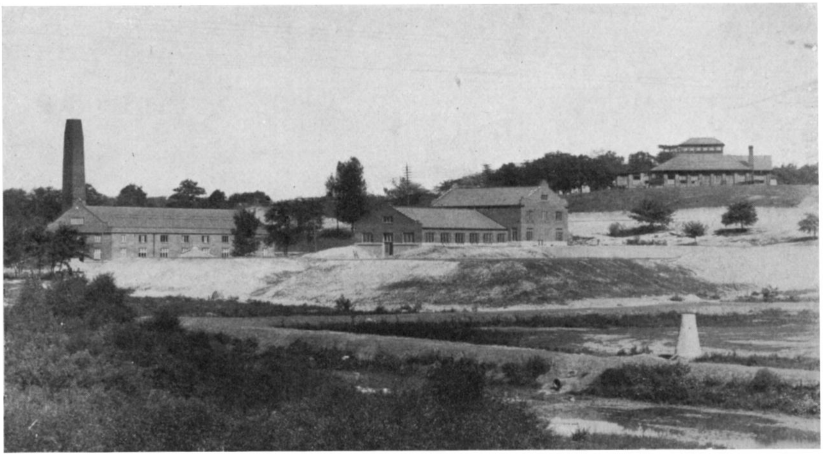
The space within the rectangular above dimensioned was reduced by a quadrangle taken from the center of the rectangle, the space thereby eliminated being approximately 71 feet by 68 feet in dimension; and, through this quadrangle, is the entrance to the filter plant galleries and to the filters and to the head house and sedimentation basins.

The space occupied by the two sedimentation basins is approximately 105 feet by 121 feet; and, there being two basins within this space of unequal dimensions, one basin has an inside dimension of 49 feet 7 inches by 100 feet 6 inches, while the larger basin has a dimension of 66 feet 2 inches by 100 feet 6 inches.

These two basins are directly attached by a common wall to the



Clear Water Basin



General View Showing Pumping Station, New Filter Plant, with the Old Filter Plant on the Hill north side of the filtration plant contained within the rectangle above described; and, on the west side of the sedimentation basins and also attached directly to the north wall of the filtration plant proper, is the head house, which is superimposed above the smaller sedimentation tank in part, and also above a mixing chamber located beneath the head house and directly adjacent to the smaller sedimentation basin; the mixing chamber is 6 inches higher, in order to furnish sufficient head by means of which the treated water can pass from the mixing chamber to the sedimentation basins.

The outside walls of these sedimentation basins are 21 inches at the base of the wall, widening out into footings, the footings being 2 feet 10 inches by 14 inches. These walls taper from a 21 inch base to 15 inches at the top. The roof or deck over these basins is substantially 7 inches thick, resting on beams 8 inches in depth; the top of the slab being at elevation 1018; and the elevation of the floor of the sedimentation basins being at elevation 1000. Consequently there is a depth within the sedimentation basin of approximately 17 feet.

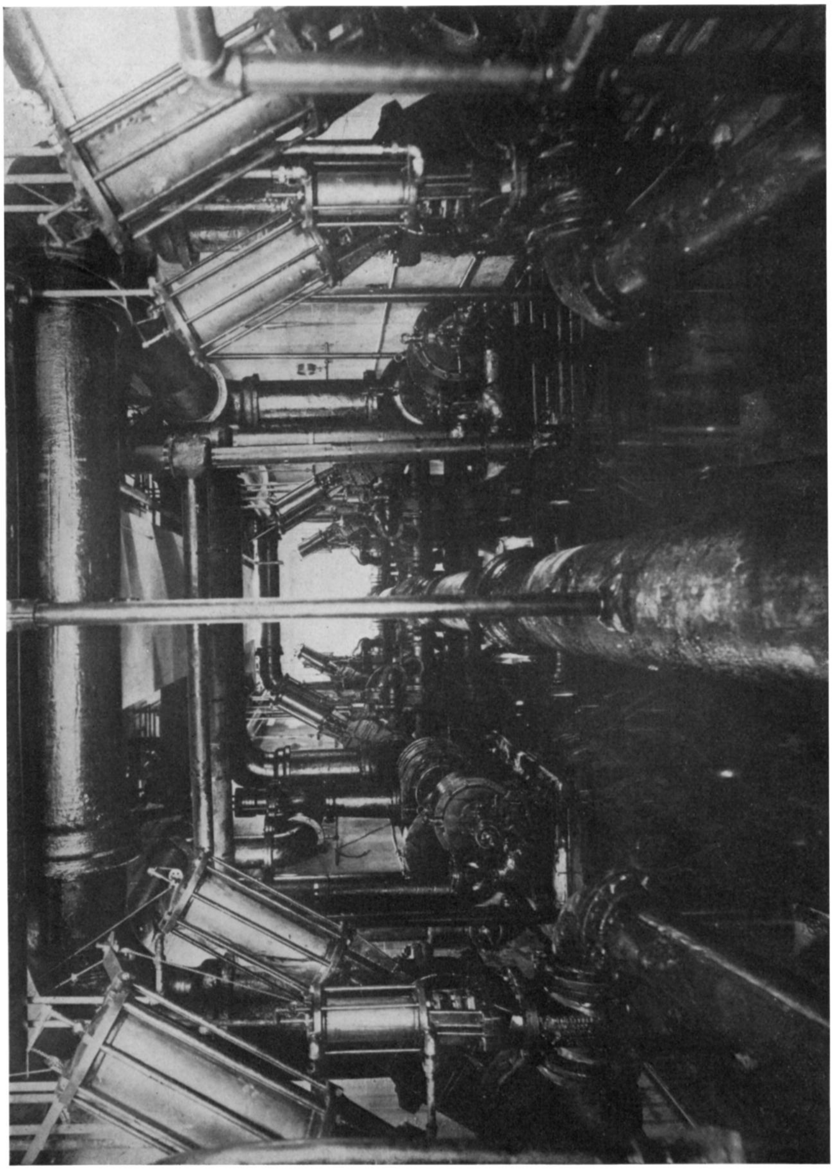
The walls of the sedimentation basins, the floor of same, as well as the beams and the roof, are heavily reinforced with steel bars, the amount of steel used in this portion of the construction being approximately 90 pounds per cubic yard. This is substantially the amount of steel also employed in the reinforcing of the clear-water well upon which the filters themselves are superimposed; the greatest percentage of steel being in the filter bottoms themselves, where approximately 95 pounds are used to the cubic yard.

The combined capacity of the sedimentation basins is approximately 1,500,000 gallons and the capacity of the clear-water well is approximately 3,000,000 gallons.

It will be seen, therefore, that there is in normal operation a period of approximately four hours sedimentation after the treated water leaves the mixing chamber and passes into the sedimentation tanks and, through them, on to the filters.

The actual area of the clear-water basin is approximately 25,000 square feet, and the depth is approximately 17 feet. The clear-water basin extends on either side beyond the filters themselves, and is decked over in much the same manner as described in the case of the sedimentation basins.

The clear-water basin is on both sides of the filters, and also connects through the space below the filters, so that the filter tanks are superimposed above the central part of the clear-water basin.



Pipe Galleries Showing Hydraulic Valves, Pump and Blower

The filters are superimposed above a relatively small part of the area occupied by this very large clear-water basin, and are supported on concrete beams.

The filter units, six in number, are the air-washing type and are each 25 feet 6 inches by 21 feet 3 inches inside dimension—this being the space actually occupied by the sand bed contained within the filter tank.

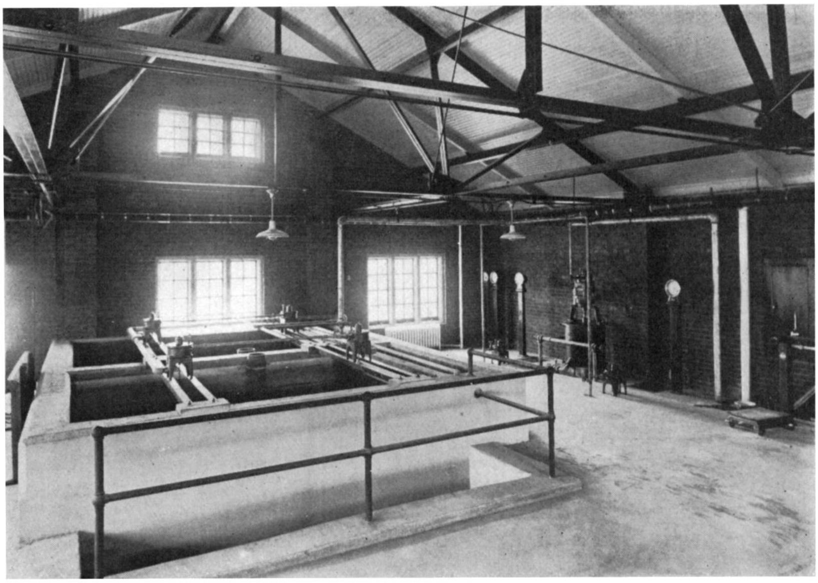
The filter tanks are 8 feet 6 inches deep from the top of the filter floor at elevation 1008 to the top of the division wall between the filters, which is at elevation 1016.45.

The walls of the filter building, which enclose the filters in part and house in the operating floor and the pipe gallery underneath, are pierced so as to permit a view from the operating floor to the extreme end of the filter unit, some 25 feet 6 inches, so that the entire filter is exposed to view from the operating platform. During operation the water from the mixing chamber passes through a flume to the sedimentation basins, entering on either side of the solid wall dividing these basins in two, and is controlled by 24-inch sluice gates at each point of entrance. Each of the basins is arranged with baffles, so that the water is forced to take a tortuous course from the point of entrance through each basin to the outlet, where the water, freed in large part of its suspended matter, is collected through another concrete flume located at a higher elevation than the inflowing flume first described. The baffles within the sedimentation basin are wooden construction, 1tted in concrete grooves.

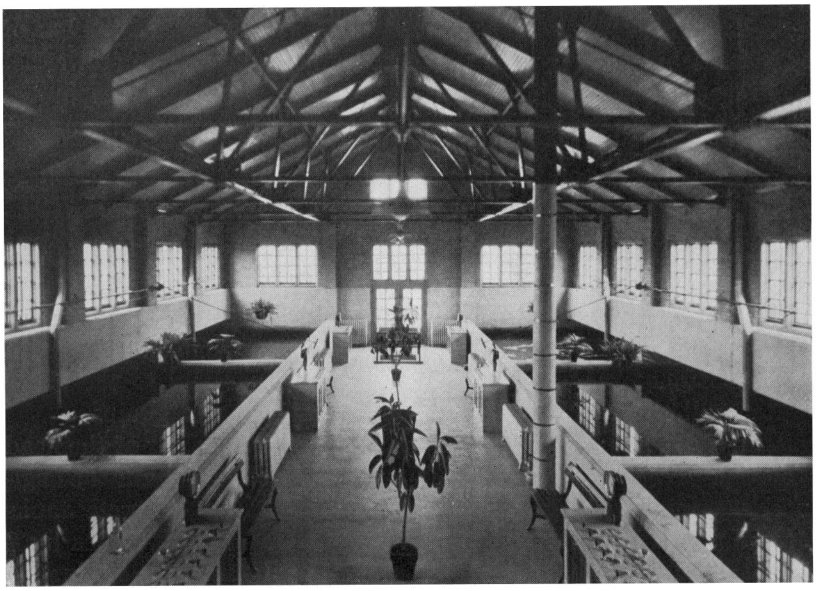
In the construction of the baffles within the mixing chamber provision is made so that the water entering there, after receiving its dose of sulphate of alumina, is forced downward and upward to insure as perfect a mixing as possible before entering the sedimentation basins where a horizontal flow is permitted from the influent to effluent flume.

From the sedimentation basins, through the filter influent flume, the water passes by gravity on to cast iron gutters arranged above the sand bed of each filter unit and within the filter area. These gutters are located so as to act like weirs in this connection, spilling the water gently on either side of the gutter with the least possible disturbance of the sand bed beneath. A constant head of water is maintained over the gutters and sand bed beneath during the filtering process.

The water then filters at the approximate rate of two gallons per square foot per minute through the sand bed and gravel under-



Mixing Room Showing Motors



Operating Room Showing Three Filters on Each Side
One and one-half Million Gallon Capacity Each

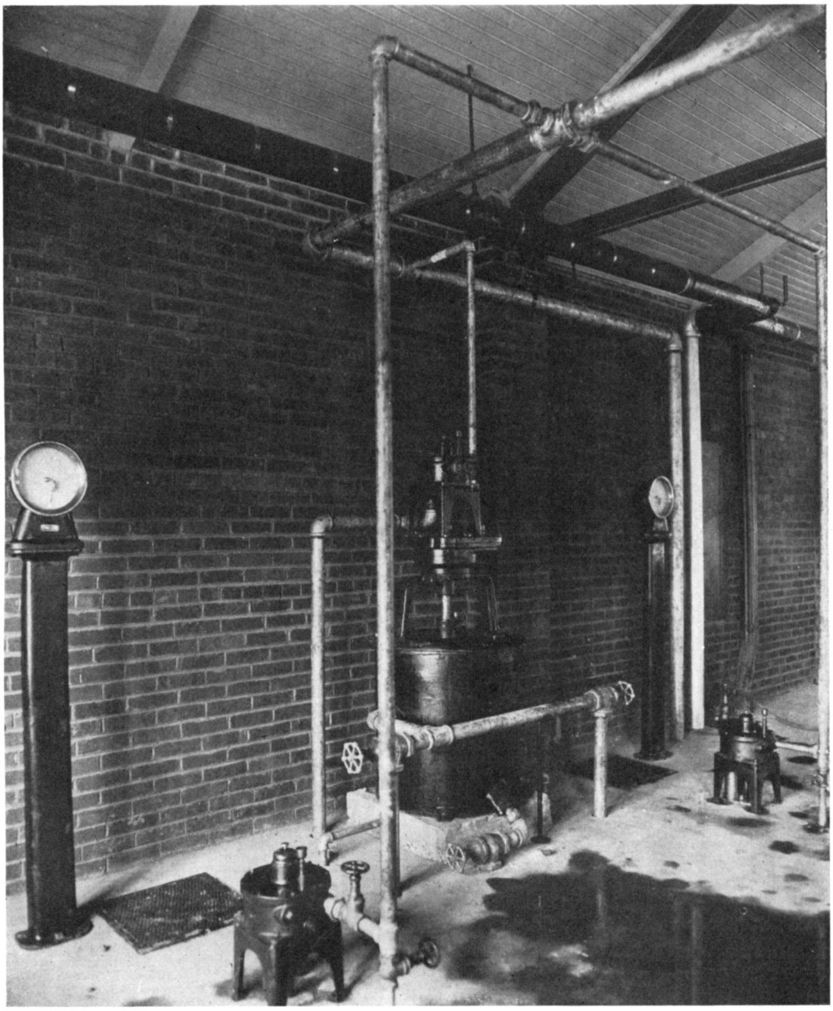
lying same and is collected through the strainer system and carried through the header piping to the controllers and thence into the clear-water well, whence it passes by gravity to a sump or suction well located just outside of the pumping house, a distance of some 300 feet from the filter building, and the large pumps supplying the city take their suction from this suction well, and force the filtered water to the city.

In washing the filters, one unit is thrown out of commission at a time, the influent valve being closed and the water within the filter tank permitted to filter down until it reaches a point about 4 inches below the top of the gutters above mentioned. These gutters during the washing period perform the function of carrying off the wash water to the sewer connection, the gutters being connected to a concrete flume so arranged as to collect the water evenly from the seven cast iron gutters located in each filter unit.

After the water is drawn below the gutters, the filtered water is forced upward by a centrifugal pump from the clear well through the header and manifold system and strainers underlying the sand and gravel bed at a rate of approximately 8½ gallons per square foot per minute. Before the wash water is permitted to enter, however, a blower is started in operation, furnishing 3 cubic feet of free air per minute against a head of 4 pounds. The function of this freed air is to break up the bed and agitate same and assist the incoming wash water which follows to thoroughly cleanse the bed, passing off the impurities which have accumulated during the washing process into the gutters and thence to the flume connecting with the sewer, and through the sewer to the Sangamon River at a point below the intake.

As this new plant took the place of wooden filters installed many years ago, there was already installed and located within the pumping station, centrifugal pumps turbine driven, and these pumps now lift the water from the Sangamon River to the mixing chamber, thence through the sedimentation basin and filters to the clear-water well, where it finally reaches the high service pumps.

The coagulant devices are located on the second floor of the head house at an elevation of 1031, in general accordance with the engineer's printed specifications, and consist of two concrete tanks of the approximate dimensions of 14 feet by 7 feet 9 inches by 8 feet. These are the tanks for the storage of the sulphate of alumina and they are equipped with dissolving racks and provided with spray pipes and floats and apparatus for the automatic shutting



Mixing Room Showing Motors, Gauges and Alum Tanks off of the water when the solution reaches a determined height in the tank. This is in order to maintain a constant percentage solution when a given amount of sulphate of alumina is dissolved.

This plant is also equipped with hypochlorite of lime devices for the sterilizing of the water after filtration; and this apparatus consists essentially of two steel tanks mounted on steel supports at an elevation similar to that of the sulphate of alumina tanks above described.

The solution from both the sulphate of alumina and the hypo solution passes to duplicate orifice boxes equipped with apparatus for the accurate control of the solution which passes into the raw water at the entrance to the mixing chamber.

The hypochlorite apparatus is equipped also with a 24-inch diameter cast iron dissolving tank mounted over the hypo solution tanks and equipped with mixing agitators, belting, shafting, etc., and into this tank the hypochlorite of lime is placed and forced to become an emulsion before being passed into the steel tanks situated below, where it mixes with water and is stored in a percentage solution through automatic shut off apparatus.

While the sulphate of alumina solution passes to the mixing chamber, the hypochlorite of lime solution passes directly to the outlet of the clear-water basin so as to insure as intimate contact as possible with the clear filtered water as it leaves the filtration plant. The filtered water is thus sterilized as it passes to the suction well.

The building over the filtration plant is of ornate design, with slate roof, steel trussed; the brick used being a dark, hard-burned brick, and the inside of the building being faced with yellow hydraulic pressed brick.

On the operating floor within the building are arranged, at each unit of filtration, operating tables of Tennessee marble, oak panelled, and surmounted thereon, are nickel plated valves which control the operation of the filter, the plant being equipped with hydraulic valves for the purpose of operation; and loss of head gauges of the indicating type giving information as to rate of flow, time to wash the filter, etc.

On the top floor of the head house a large room is provided for storage of sulphate of alumina and hypochlorite of lime. Access is had to this floor by means of an elevator which communicates from the ground floor up to the storage and chemical mixing room, which are on the same floor.